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# IMAGES ARE BEST AVAILABLE COPY.

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FIG. 1

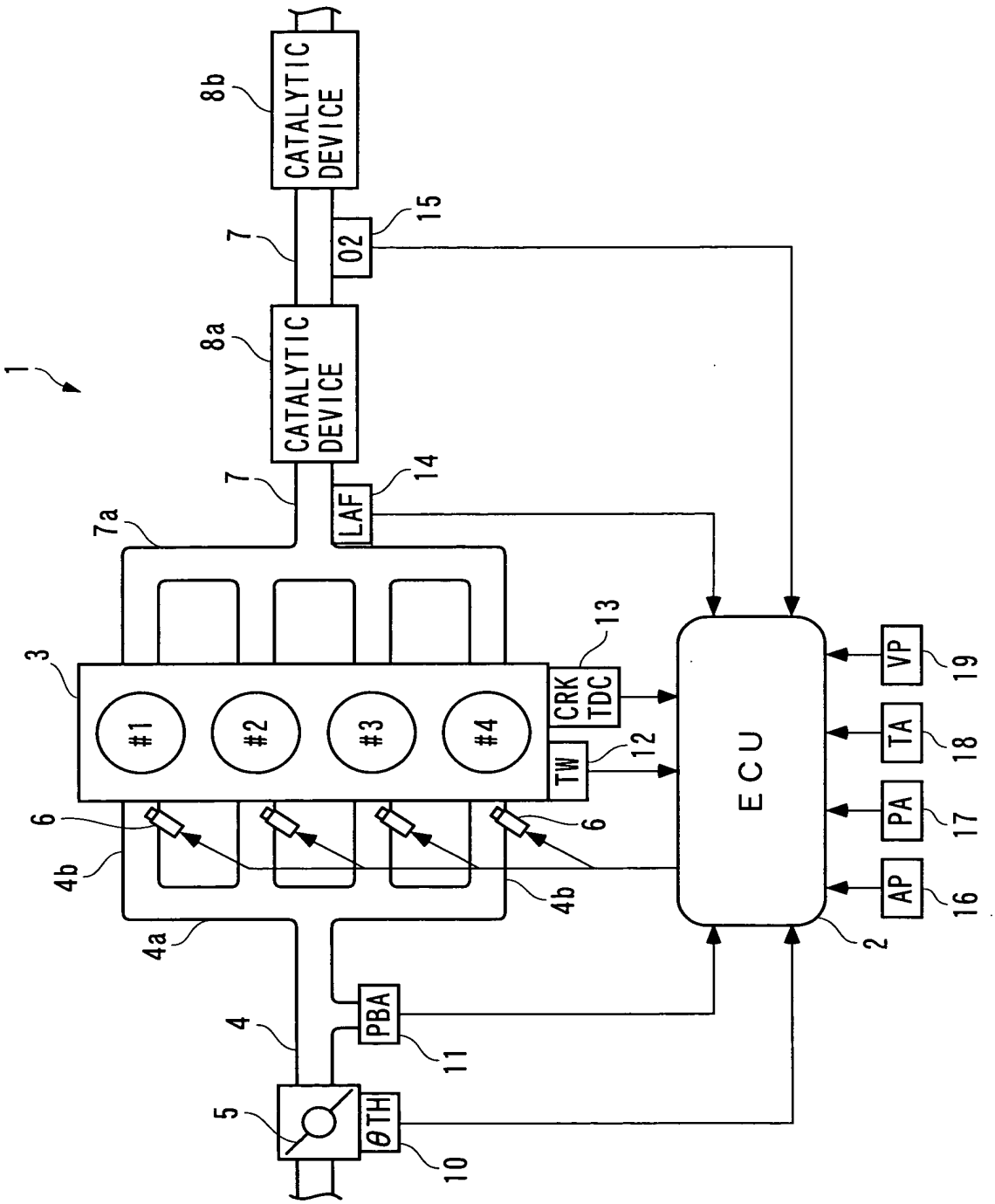

1
2
3
4
4a
4b
5
6
7
7a
8a
8b
10
11
12
13
14
15
16
17
18
19
#1
#2
#3
#4
CATALYTIC DEVICE
CATALYTIC DEVICE
O2
LAF
CRK
TDC
TW
θTH
PBA
ECU
AP
PA
TA
VP

FIG. 2

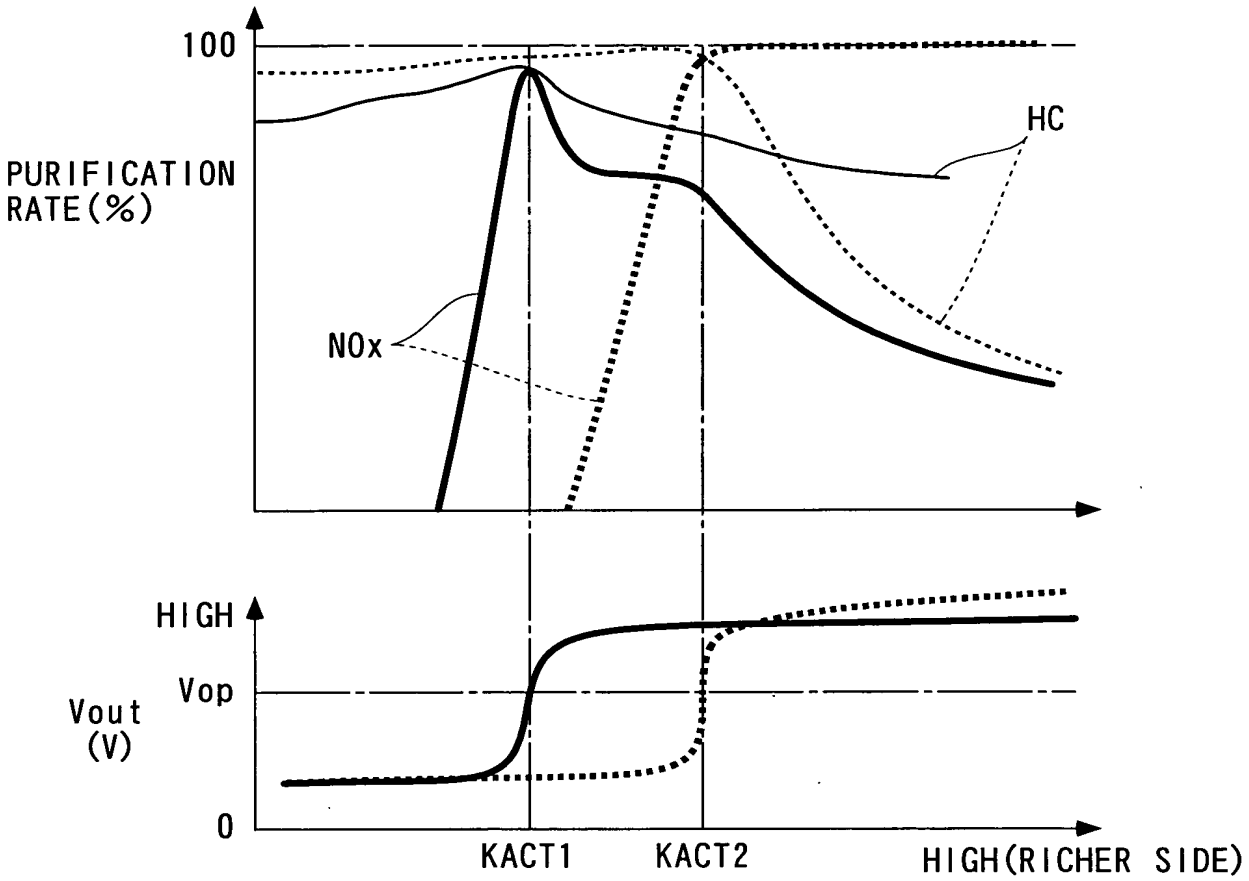

100
PURIFICATION RATE(%)
HC
NOx
HIGH
Vop
Vout (V)
0
KACT1
KACT2
HIGH(RICHER SIDE)
KACT

FIG. 3

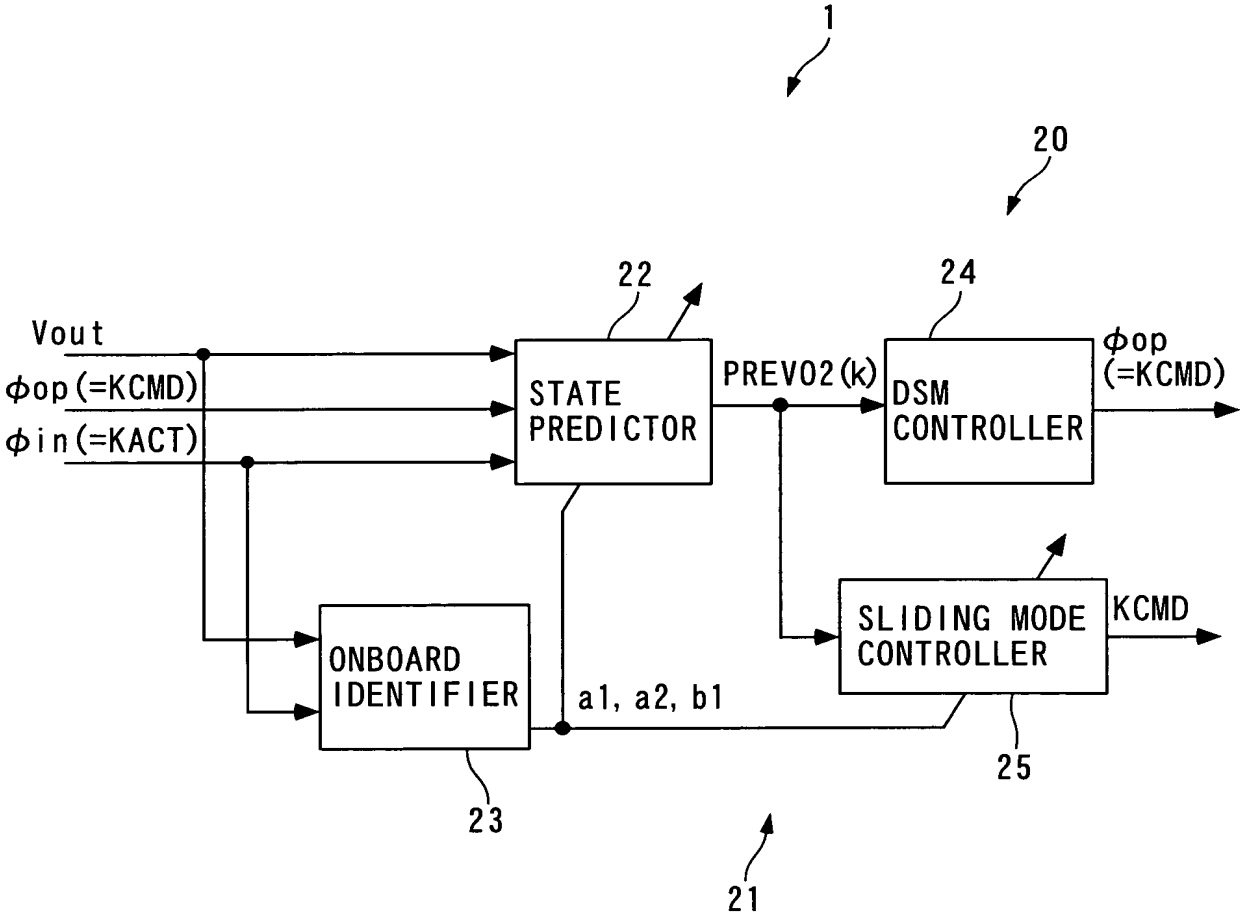

1
20
22
24
Vout
φop(=KCMD)
φin(=KACT)
STATE PREDICTOR
PREV02(k)
DSM CONTROLLER
φop (=KCMD)
SLIDING MODE CONTROLLER
KCMD
ONBOARD IDENTIFIER
a1, a2, b1
23
25
21

FIG. 4

$$A=\begin{bmatrix} a1 & a2 \\ 1 & 0 \end{bmatrix} \quad \cdots\cdots (4)$$

$$B=\begin{bmatrix} b1 \\ 0 \end{bmatrix} \quad \cdots\cdots (5)$$

$$PREVO2(k)=\alpha 1\cdot VO2(k)+\alpha 2\cdot VO2(k-1)+\sum_{i=1}^{dt}\beta i\cdot DKCMD(k-i) \quad \cdots\cdots (6)$$

wherein $\alpha 1$ : first-row first-column element of $A^{dt}$
$\alpha 2$ : first-row second-column element of $A^{dt}$
$\beta i$ : first-row element of $A^{i-1}B$

$$PREVO2(k)=\alpha 1\cdot VO2(k)+\alpha 2\cdot VO2(k-1)+\sum_{i=1}^{d'-1}\beta i\cdot DKCMD(k-i)+\sum_{j=d'}^{dt}\beta j\cdot DKACT(k-j) \quad \cdots\cdots (7)$$

wherein $\beta j$ : first-row element of $A^{j-1}B$

FIG. 5

$$\theta(k)=\theta(k-1)+KP(k)\cdot ide_f(k) \quad \cdots\cdots (8)$$

$$\theta(k)^T=[a1(k),\ a2(k),\ b1(k)] \quad \cdots\cdots (9)$$

$$ide_f(k)=\frac{1}{n}\sum_{i=1}^{n} ide(i) \quad \cdots\cdots (10)$$

$$ide(k)=VO2(k)-VO2HAT(k) \quad \cdots\cdots (11)$$

$$VO2HAT(k)=\theta(k-1)^T\zeta(k) \quad \cdots\cdots (12)$$

$$\zeta(k)^T=[VO2(k-1),\ VO2(k-2),\ DKACT(k-d-dd)] \quad \cdots\cdots (13)$$

$$KP(k)=\frac{P(k)\ \zeta(k)}{1+\zeta(k)^T\ P(k)\ \zeta(k)} \quad \cdots\cdots (14)$$

$$P(k+1)=\frac{1}{\lambda_1}\left(I-\frac{\lambda_2 P(k)\ \zeta(k)\ \zeta(k)^T}{\lambda_1+\lambda_2\ \zeta(k)^T\ P(k)\ \zeta(k)}\right)P(k) \quad \cdots\cdots (15)$$

wherein, I represents a unit matrix.

FIG. 6

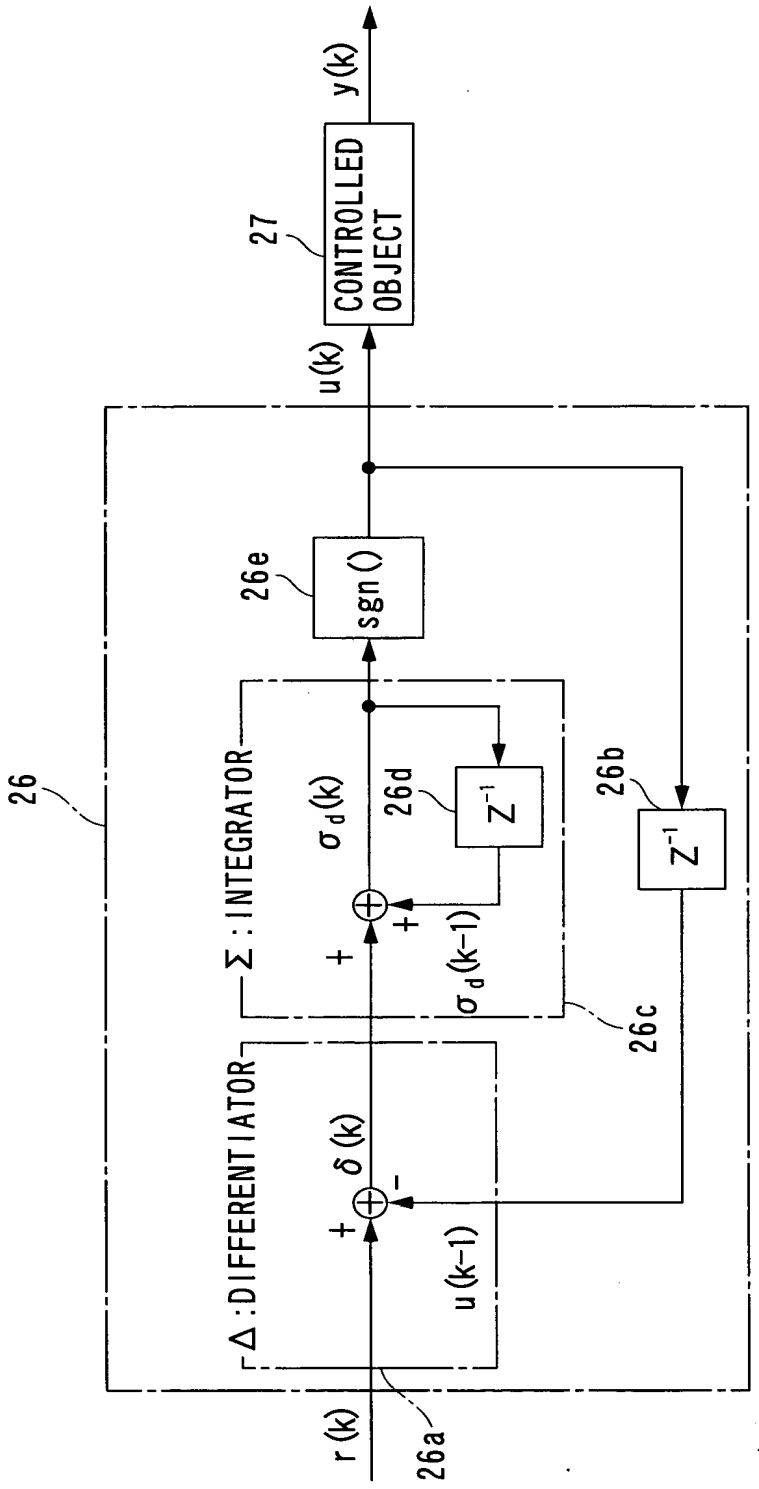

y(k)
27
CONTROLLED OBJECT
u(k)
26
26e
sgn ()
Σ : INTEGRATOR
σd(k)
26d
Z-1
26b
Z-1
+
+
σd(k-1)
26c
Δ : DIFFERENTIATOR
δ (k)
+
-
u (k-1)
r (k)
26a

FIG. 7

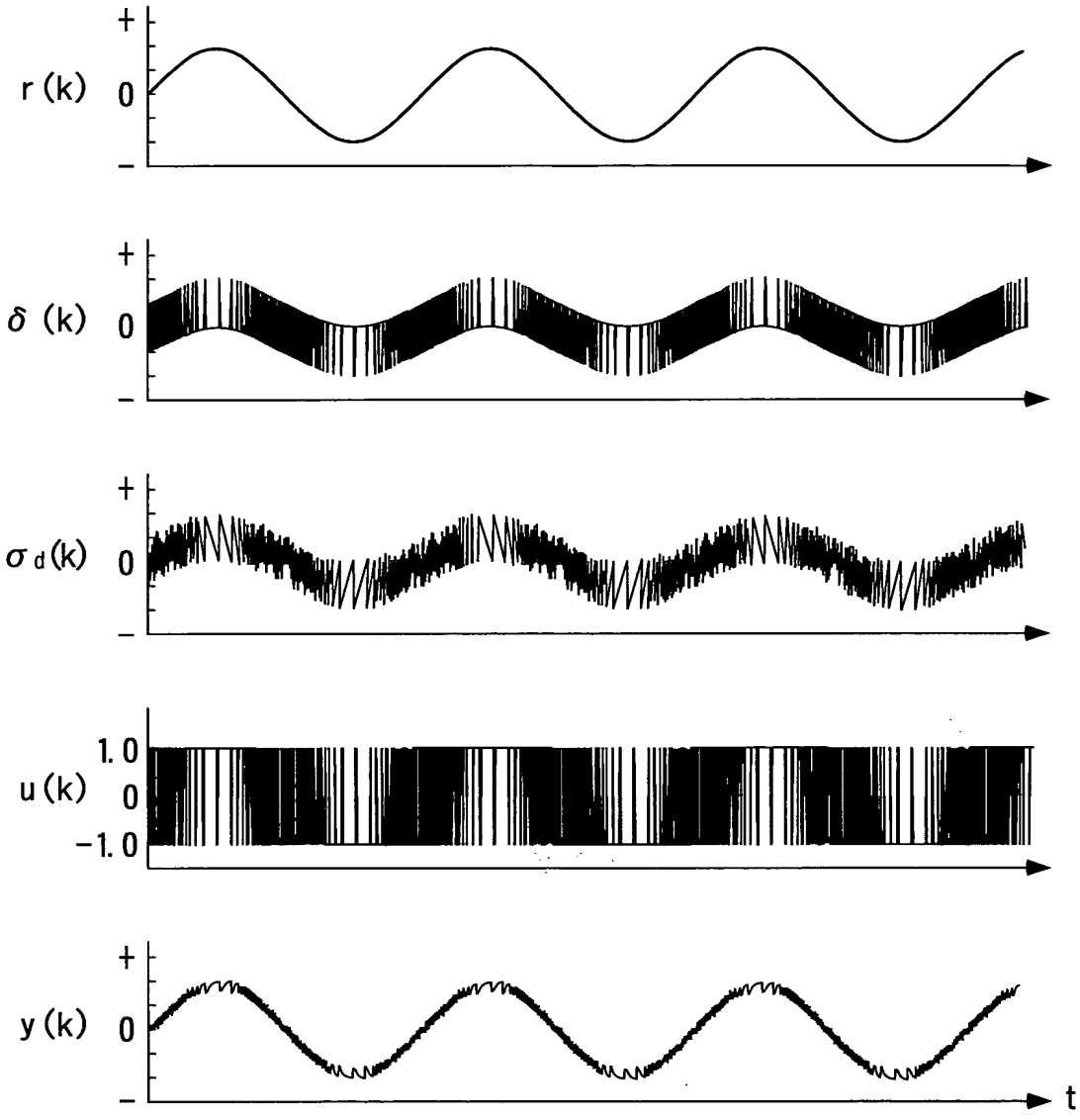


FIG. 8

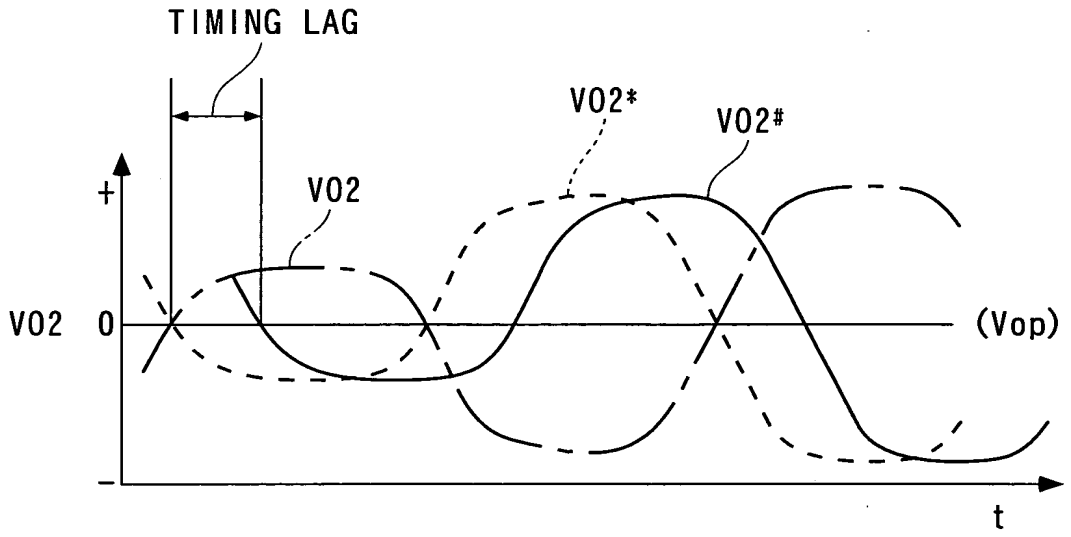


FIG. 9

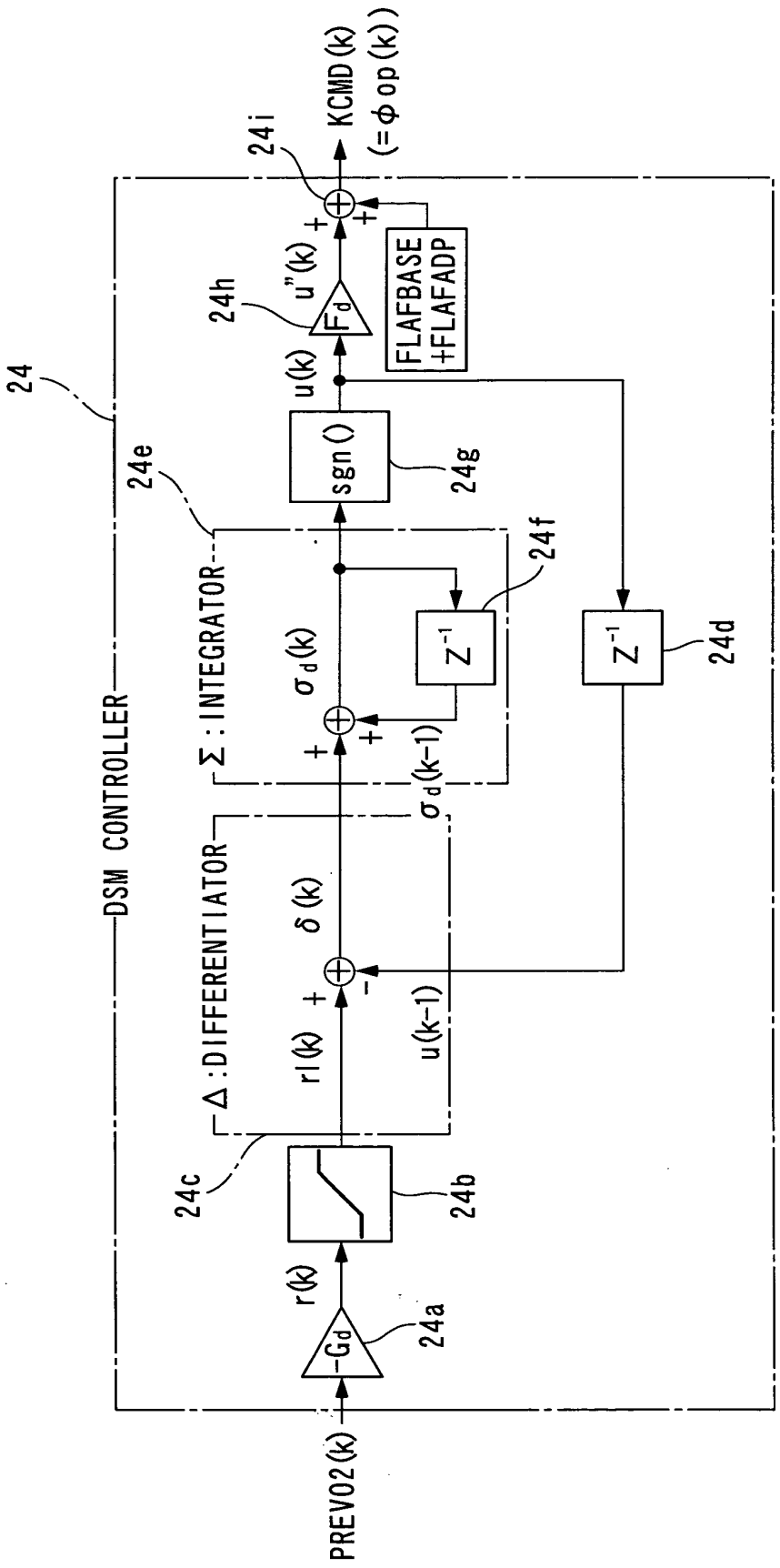

PREVO2(k)
DSM CONTROLLER
24
r(k)
-Gd
24a
24c
24b
Δ:DIFFERENTIATOR
r1(k)
δ(k)
u(k-1)
Σ:INTEGRATOR
σd(k)
σd(k-1)
24e
24f
Z-1
24d
sgn()
24g
u(k)
Fd
24h
u"(k)
FLAFBASE
+FLAFADP
24i
KCMD(k)
(=φop(k))

FIG. 10

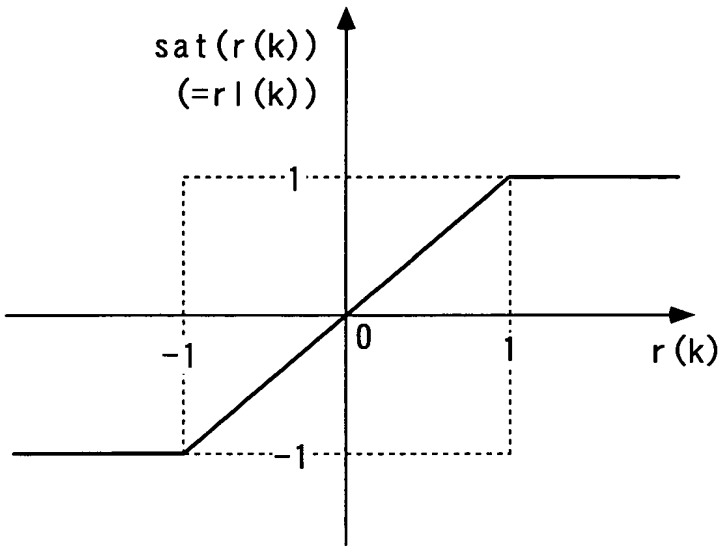


FIG. 11

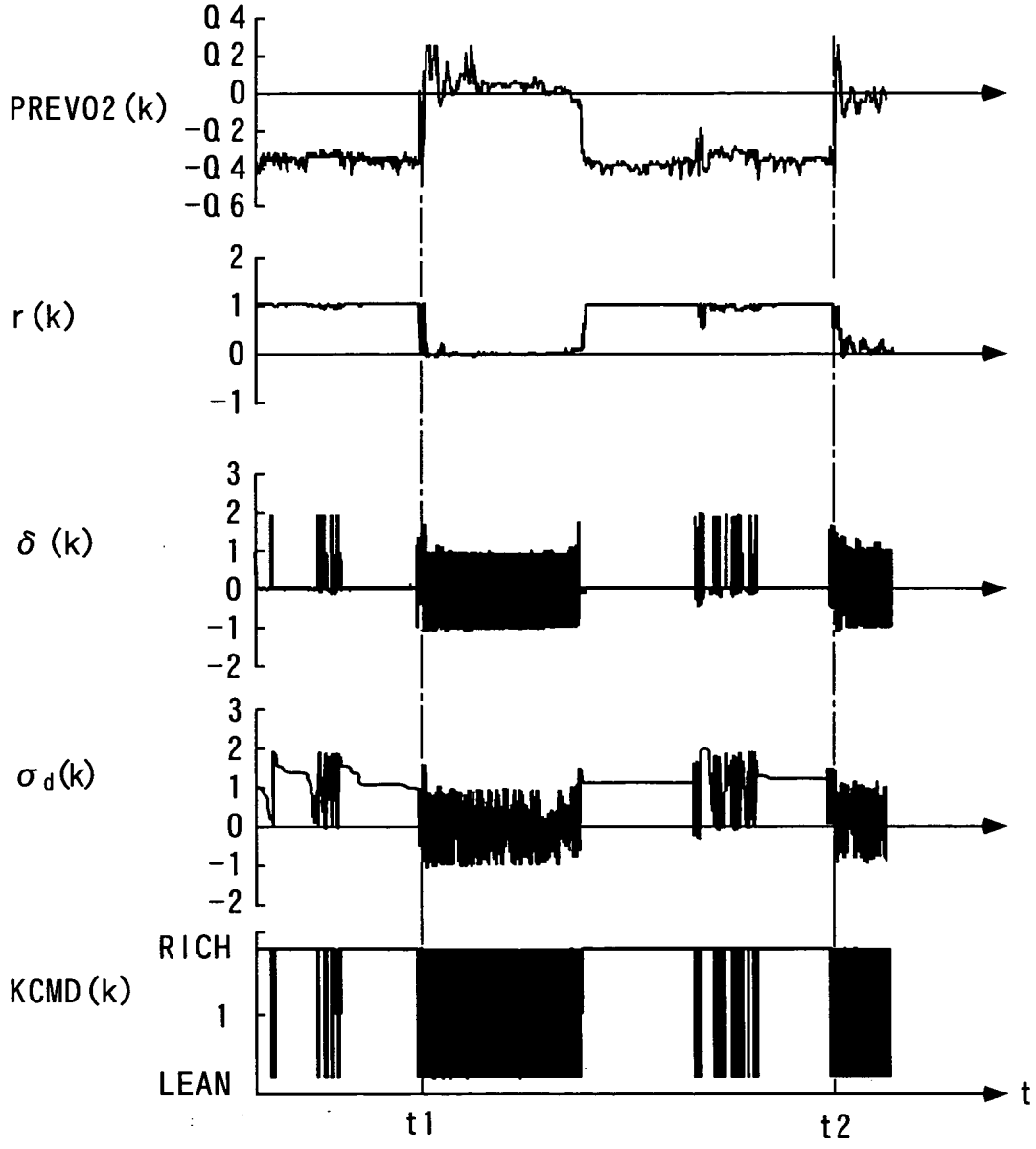

PREVO2(k)
0.4
0.2
0
-0.2
-0.4
-0.6
r(k)
2
1
0
-1
δ(k)
3
2
1
0
-1
-2
σd(k)
3
2
1
0
-1
-2
KCMD(k)
RICH
1
LEAN
t
t1
t2

FIG. 12

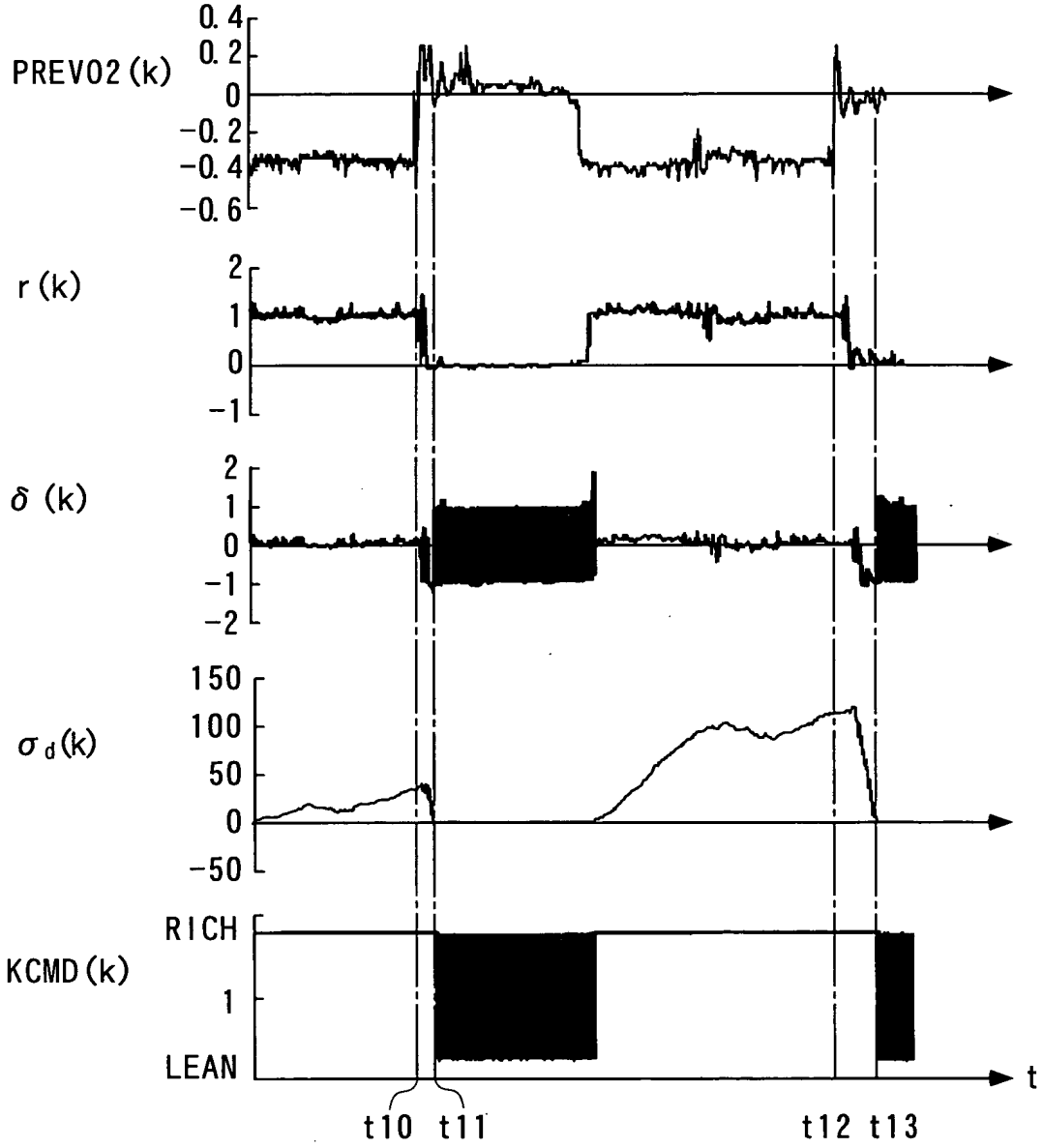

PREVO2(k)
0.4
0.2
0
-0.2
-0.4
-0.6
r(k)
2
1
0
-1
δ(k)
2
1
0
-1
-2
σd(k)
150
100
50
0
-50
KCMD(k)
RICH
1
LEAN
t
t10
t11
t12
t13

FIG. 13

$$\sigma PRE(k)=S1\cdot PREVO2(k)+S2\cdot PREVO2(k-1) \quad \cdots\cdots (26)$$

$$Usl(k)=Ueq(k)+Urch(k)+Uadp(k) \quad \cdots\cdots (27)$$

$$Ueq(k)=\frac{-1}{S1\cdot b1}\{[S1\cdot(a1-1)+S2]\cdot PREVO2(k) + (S1\cdot a2-S2)\cdot PREVO2(k-1)\} \quad \cdots\cdots (28)$$

$$Urch(k)=\frac{-F}{S1\cdot b1}\cdot\sigma PRE(k) \quad \cdots\cdots (29)$$

$$Uadp(k)=\frac{-G}{S1\cdot b1}\sum_{i=0}^{k}\Delta T\cdot\sigma PRE(i) \quad \cdots\cdots (30)$$

FIG. 14

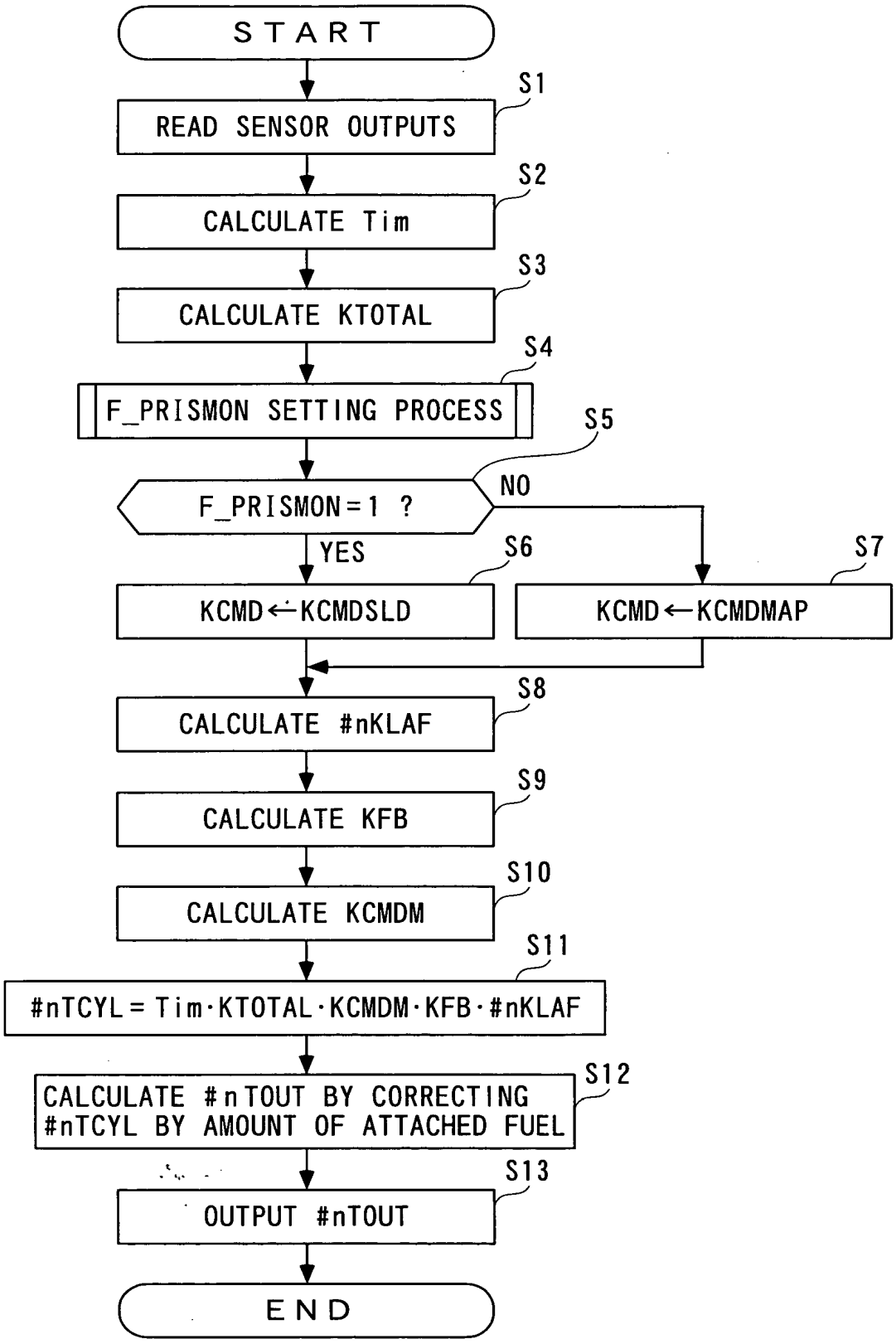

START
S1
READ SENSOR OUTPUTS
S2
CALCULATE Tim
S3
CALCULATE KTOTAL
S4
F_PRISMON SETTING PROCESS
S5
F_PRISMON=1 ?
NO
YES
S6
KCMD←KCMDSLD
S7
KCMD←KCMDMAP
S8
CALCULATE #nKLAF
S9
CALCULATE KFB
S10
CALCULATE KCMDM
S11
#nTCYL=Tim·KTOTAL·KCMDM·KFB·#nKLAF
S12
CALCULATE #nTOUT BY CORRECTING #nTCYL BY AMOUNT OF ATTACHED FUEL
S13
OUTPUT #nTOUT
END

FIG. 15

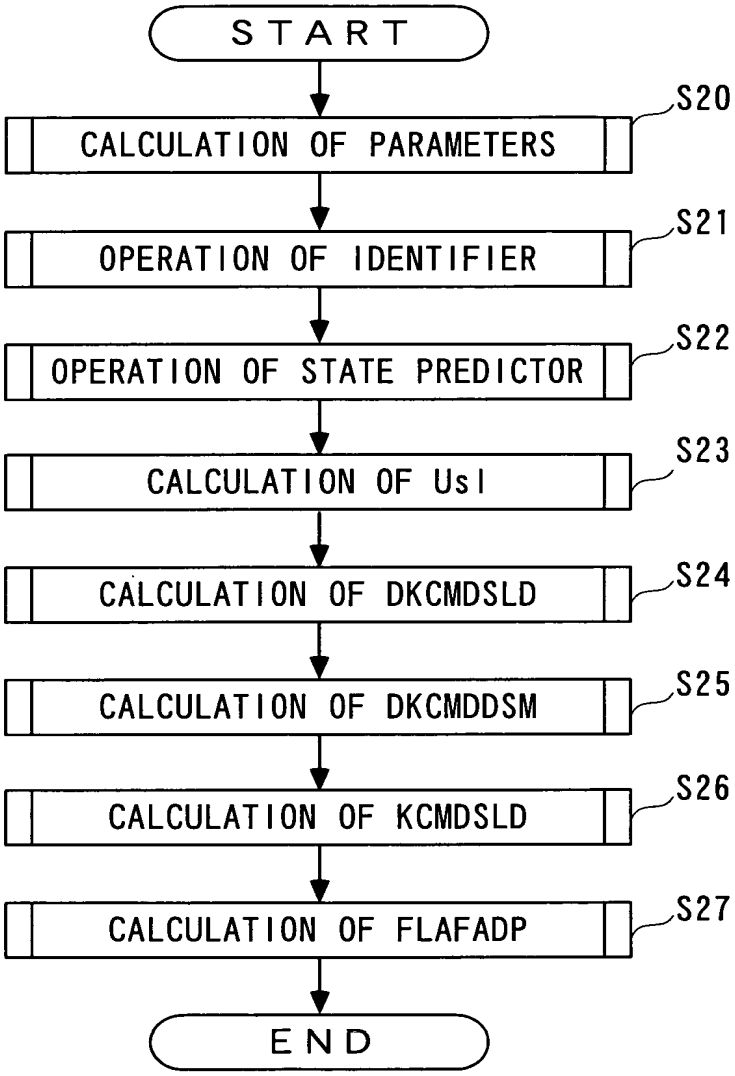

START
CALCULATION OF PARAMETERS
S20
OPERATION OF IDENTIFIER
S21
OPERATION OF STATE PREDICTOR
S22
CALCULATION OF Usl
S23
CALCULATION OF DKCMDSLD
S24
CALCULATION OF DKCMDDSM
S25
CALCULATION OF KCMDSLD
S26
CALCULATION OF FLAFADP
S27
END

FIG. 16

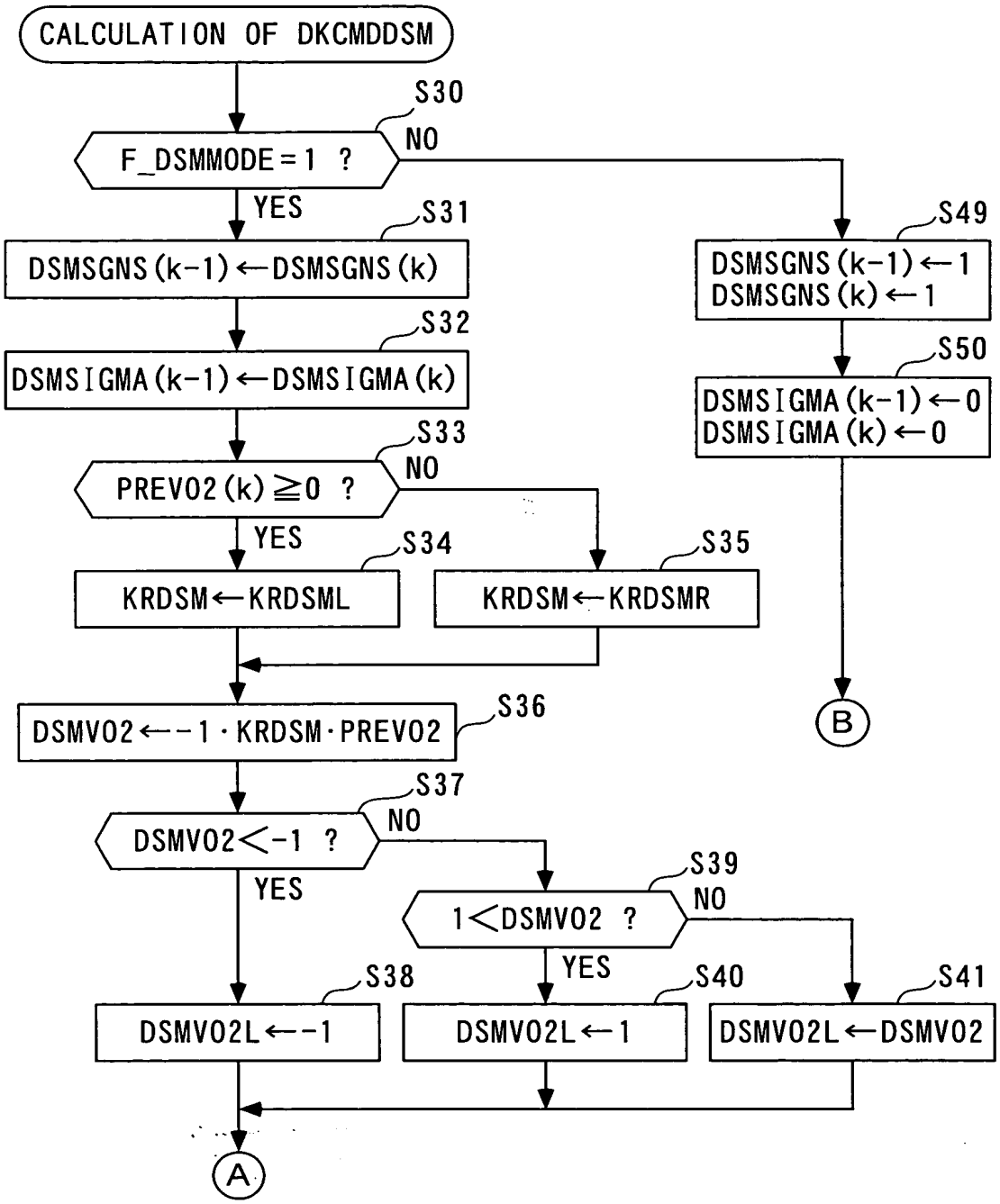

CALCULATION OF DKCMDDSM
S30
F_DSMMODE=1 ?
NO
YES
S31
DSMSGNS(k-1)←DSMSGNS(k)
S32
DSMSIGMA(k-1)←DSMSIGMA(k)
S33
PREVO2(k)≧0 ?
NO
YES
S34
KRDSM←KRDSML
S35
KRDSM←KRDSMR
S36
DSMVO2←-1·KRDSM·PREVO2
S37
DSMVO2<-1 ?
NO
YES
S38
DSMVO2L←-1
S39
1<DSMVO2 ?
NO
YES
S40
DSMVO2L←1
S41
DSMVO2L←DSMVO2
A
S49
DSMSGNS(k-1)←1
DSMSGNS(k)←1
S50
DSMSIGMA(k-1)←0
DSMSIGMA(k)←0
B

FIG. 17

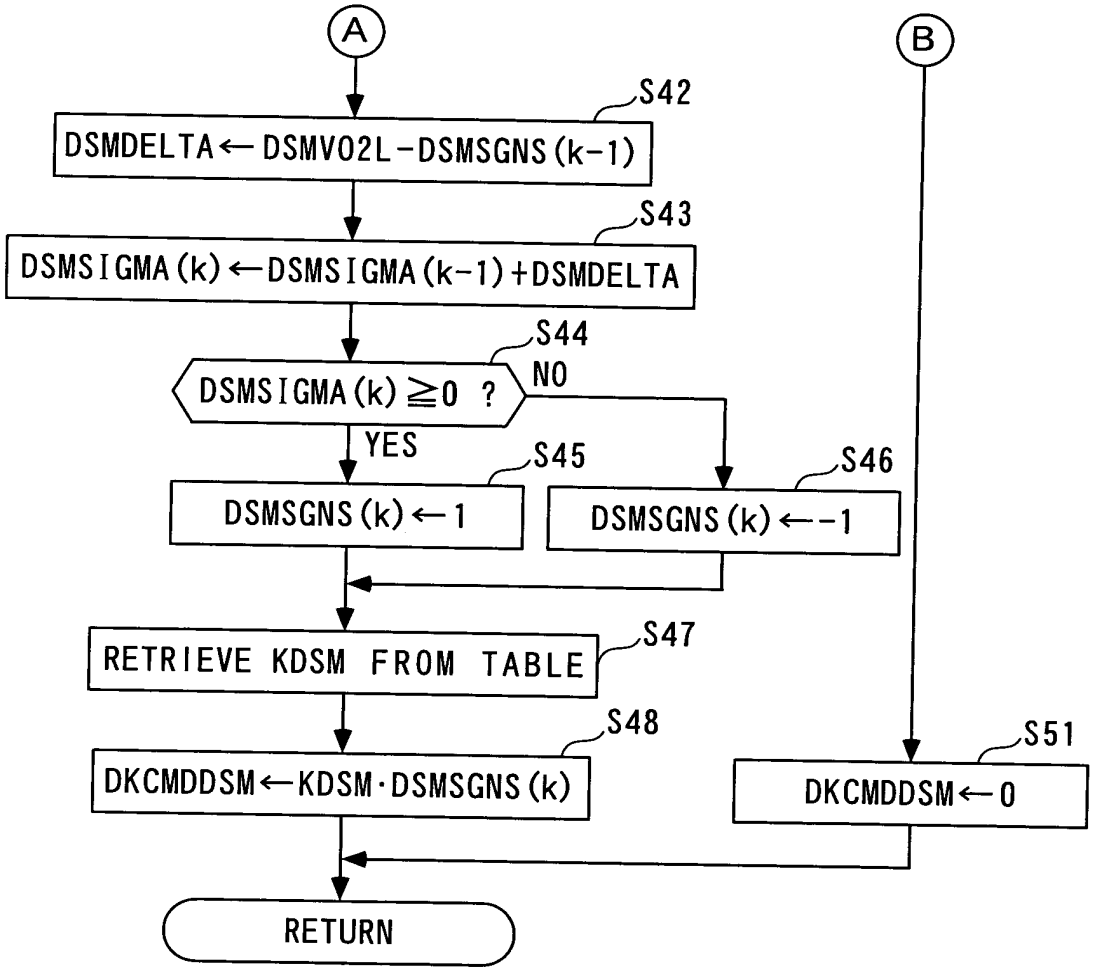

A
B
S42
DSMDELTA←DSMV02L−DSMSGNS(k−1)
S43
DSMSIGMA(k)←DSMSIGMA(k−1)+DSMDELTA
S44
DSMSIGMA(k)≧0 ?
NO
YES
S45
DSMSGNS(k)←1
S46
DSMSGNS(k)←−1
RETRIEVE KDSM FROM TABLE
S47
S48
DKCMDDSM←KDSM·DSMSGNS(k)
S51
DKCMDDSM←0
RETURN

FIG. 18

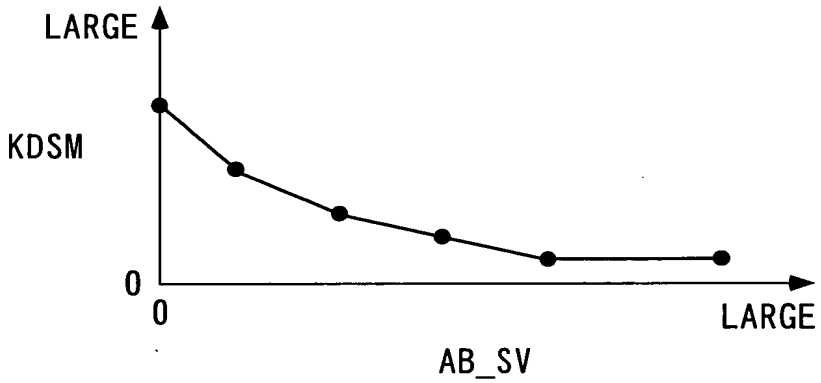


FIG. 19

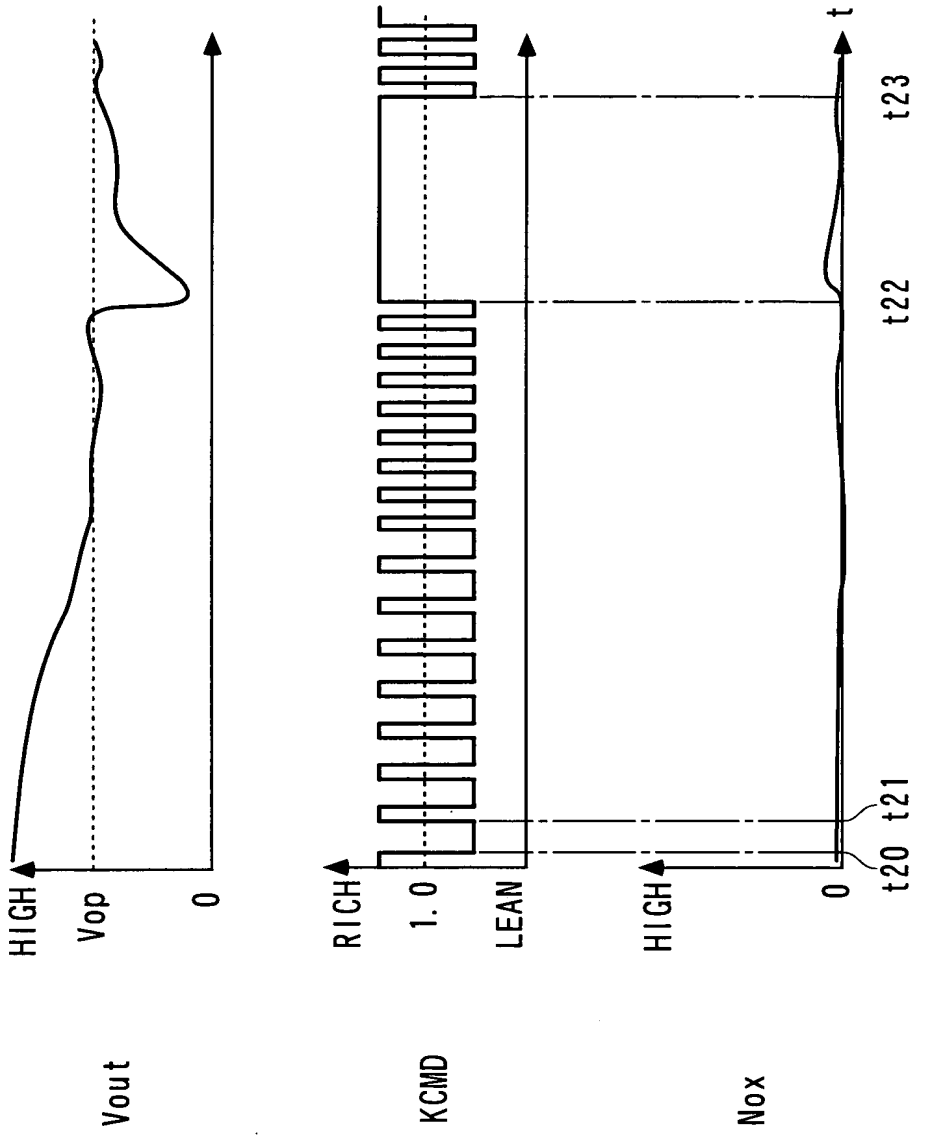


FIG. 20

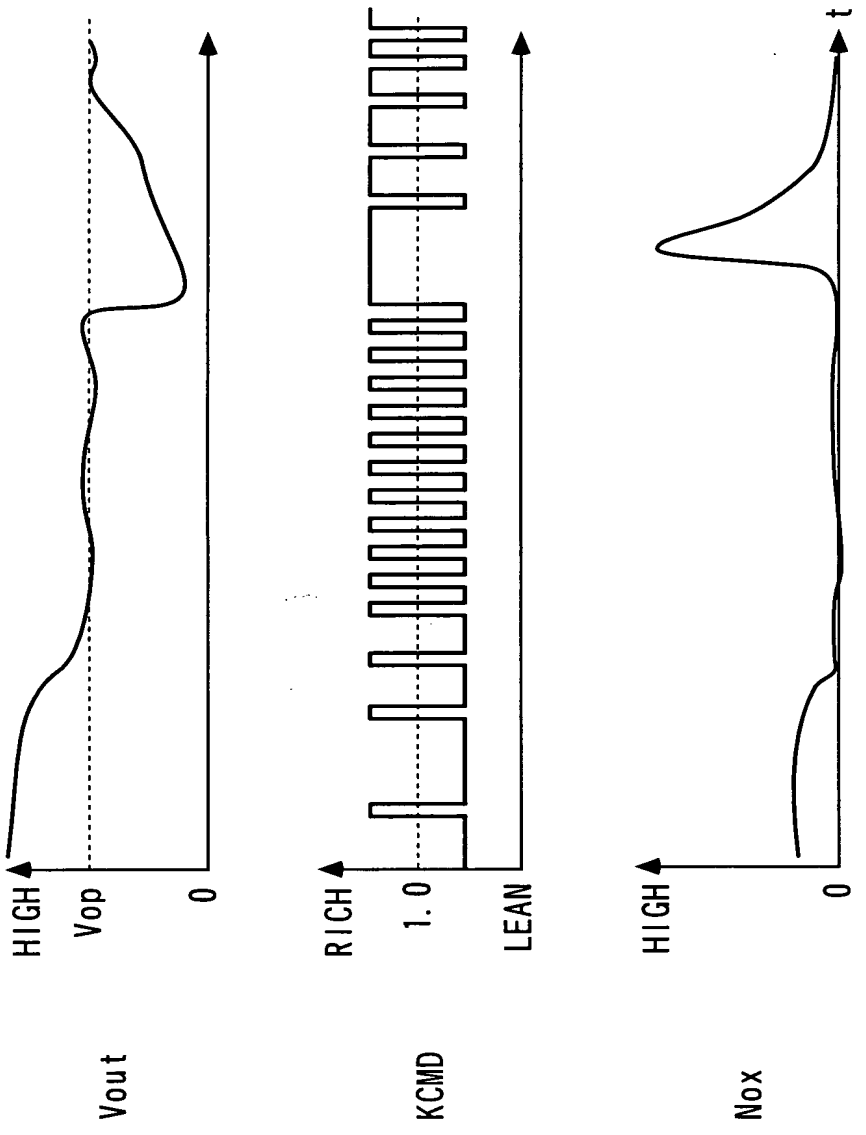


FIG. 21

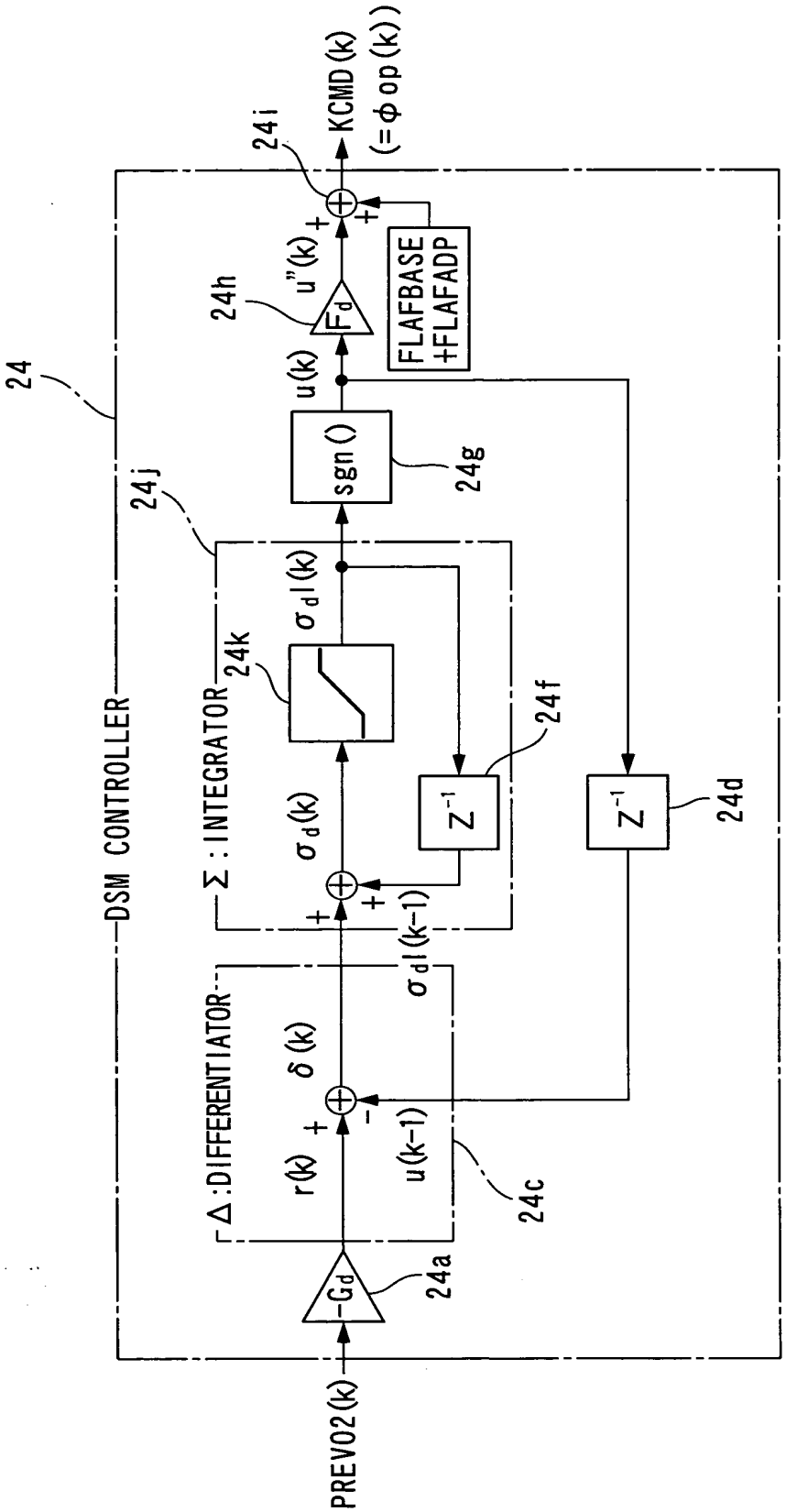

24
DSM CONTROLLER
PREVO2(k)
-Gd
24a
Δ:DIFFERENTIATOR
r(k)
δ(k)
u(k-1)
σdI(k-1)
24c
Σ:INTEGRATOR
σd(k)
σdI(k)
24k
24j
Z-1
24f
Z-1
24d
sgn()
24g
u(k)
Fd
24h
u"(k)
FLAFBASE
+FLAFADP
24i
KCMD(k)
(=φop(k))

FIG. 22

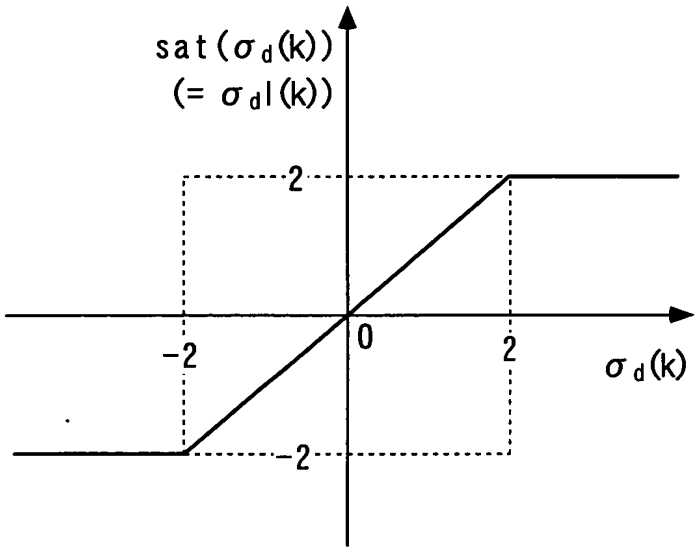


FIG. 23

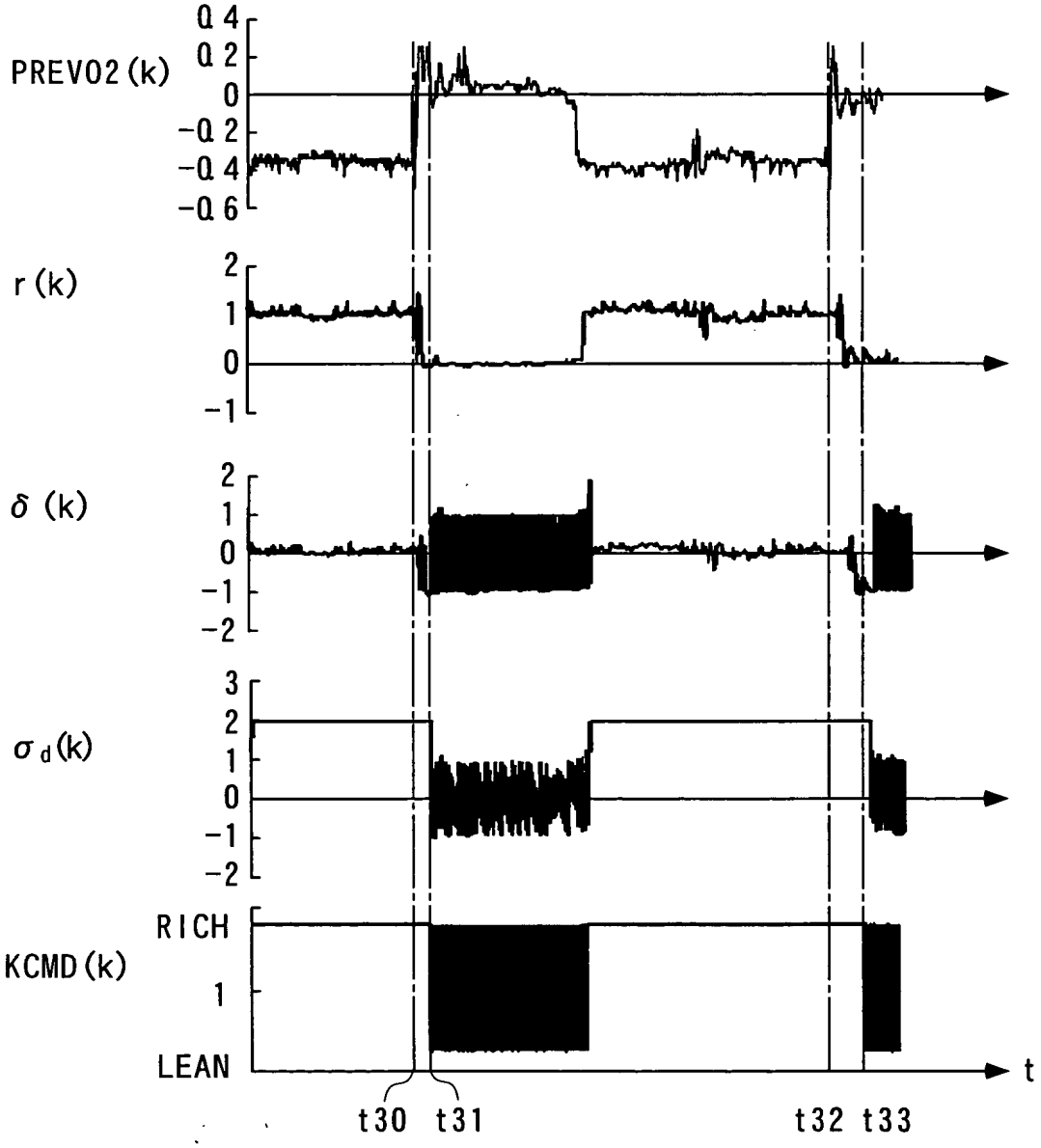
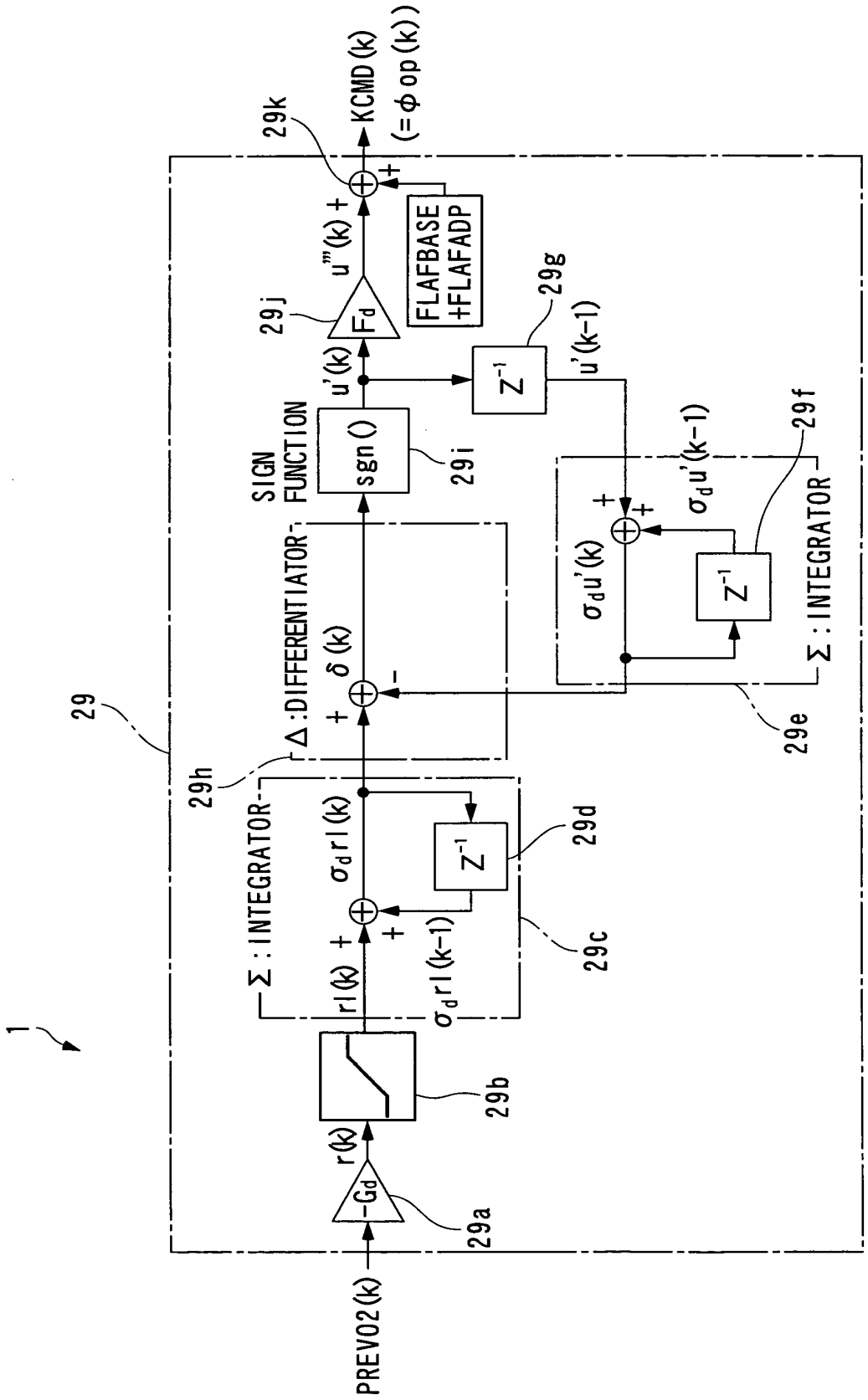

PREVO2(k)
0.4
0.2
0
-0.2
-0.4
-0.6
r(k)
2
1
0
-1
δ(k)
2
1
0
-1
-2
σd(k)
3
2
1
0
-1
-2
KCMD(k)
RICH
1
LEAN
t
t30
t31
t32
t33

FIG. 24


1
29
PREVO2(k)
r(k)
-Gd
29a
29b
Σ : INTEGRATOR
rl(k)
σdrl(k)
σdrl(k-1)
29c
Z-1
29d
Δ :DIFFERENTIATOR
δ(k)
29h
SIGN FUNCTION
sgn()
29i
u'(k)
Fd
29j
u'''(k)
29k
KCMD(k)
(=φop(k))
FLAFBASE +FLAFADP
Z-1
u'(k-1)
29g
σdu'(k)
σdu'(k-1)
Z-1
29f
Σ : INTEGRATOR
29e